

**A new species of *Goreopagurus* McLaughlin
(Decapoda: Anomura: Paguridae) from the Pacific, and a
comparison with its Atlantic counterpart**

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Abstract.—*Goreopagurus garthi*, a new species of hermit crab, is described and illustrated. This Pacific representative of the heretofore monotypic, Atlantic genus *Goreopagurus* has necessitated minor emendations to the generic diagnosis. The similarities and differences between the two species are discussed.

Goreopagurus was erected by McLaughlin (1988) for *Pagurus piercei* Wass, 1963, a very distinctive western Atlantic species, known at the time of its original description from a single male specimen. When additional collections were critically examined, it became apparent that Wass' (1963) assignment of this species to *Pagurus* was incorrect. A suite of characters including the presence of a pair of pleopods, modified as gonopods, in females and a very short sexual tube on the right fifth coxa in males, phyllobranchiate gills, and highly distinctive chelipeds set *Goreopagurus* apart from all other members of the Paguridae.

Before publication of McLaughlin's (1988) paper, one of us (JH) had found several specimens in the collections of the Allan Hancock Foundation that bore a marked resemblance to *P. piercei*. Originally reported as *Pagurus* sp. (2) (Haig et al. 1970), they were subsequently cataloged into the collection simply as "genus?, sp. H." We have now had the opportunity to reexamine these specimens and confirm that they belong to *Goreopagurus*. McLaughlin's (1988) diagnosis, based exclusively on *G. piercei*, was rather restrictive. The discovery of *Goreopagurus garthi*, new species, necessitates minor emendations to the generic diagnosis.

One male and one female paratype have been deposited in the collections of the National Museum of Natural History, Smithsonian Institution (USNM). The holotype and remaining paratypes currently in the Allan Hancock Foundation (AHF), will eventually be housed in the Crustacea collection of the Natural History Museum of Los Angeles County (LACM). Comparative material of *G. piercei* from *Oculina* samples taken from Jeff's Reef, Florida, have been provided by the Harbor Branch Oceanographic Museum (HBOM). The length of the shield (SL), as measured from the tip of the rostrum to the midpoint of the posterior margin of the shield, is an indicator of specimen size. The symbols ♂, ♀, and ♀♀ refer to male, female, and ovigerous female respectively.

Goreopagurus McLaughlin, 1988

Emended diagnosis.—Eleven pairs of phyllobranch gills. Ocular acicles triangular, with strong submarginal spine; separated basally by basal width or more of 1 acicle. Antennal peduncle with supernumerary segmentation. Maxillule with internal lobe moderately well developed, with 1 stiff bristle; external lobe produced, not recurved.

Third maxilliped with well developed crista dentata and prominent accessory tooth; merus with or without dorsodistal spine. Sternite of third maxillipeds with or without small spine on either side of midline.

Right cheliped with chela very elongate, narrow; articulation with carpus generally perpendicular. Carpus strongly produced ventrally, dorsomesial margin weakly to greatly expanded. Left cheliped appreciably shorter than right; chela narrow, weakly triangular in cross-section, articulation with carpus perpendicular. Sternite of third pereopods with anterior lobe semisubovate, subquadrate or subrectangular. Sternite of fifth pereopods with 2 ovate or subcircular lobes. Fourth pereopods with propodal rasp consisting of 1 row of corneous scales; dactyl with or without preungual process.

Mature males with coxae of fifth pereopods generally symmetrical; vas deferens of right produced as short sexual tube, often directed laterally or posteriorly and sometimes partially obscured by posterior tuft of setae; coxa of left often with vas deferens slightly produced; with 3 unpaired uniramous or weakly biramous pleopods. Females with paired gonopores; well developed, paired first pleopods modified as gonopods; 4 unpaired pleopods, second to fourth with both rami well developed, fifth with endopod rudimentary or absent.

Abdomen flexed. Uropods asymmetrical. Telson with transverse suture; posterior lobes symmetrical or somewhat asymmetrical, separated by small median cleft; terminal margins oblique or straight, each armed with few to several small spines; lateral margins frequently delimited by narrow chitinous plate.

Goreopagurus garthi, new species

Figs. 1, 2, 3A, 4A

Pagurus, undescribed species (2): Haig et al. 1970:20.

Holotype.—1 ♂ (SL 2.27 mm), 29 mi S. of Punta Abreojos, west coast of Baja Cal-

ifornia, Mexico, "Velero IV" sta 1710-49, 95-102 m, 7 Mar 1949, LACM 49-55.9 (AHF 4926).

Paratypes.—West coast of Baja California, Mexico: 1 ♂ (SL 1.70 mm), 8 mi W of Isla Cedros, *Velero III* sta 1253-41, 117-119 m, 26 Feb 1941, LACM 41-33.20 (AHF 4135).—2 ♀♀ (SL 2.21, 2.30 mm), 29 mi S. of Punta Abreojos, *Velero IV* sta 1710-49, 95-102 m, 7 Mar 1949, LACM 49-55.8 (AHF 4927).—2 ♂♂ (SL 1.31, 1.55 mm), 1 ♀ (SL 1.25), 1 ♀♀ (SL 1.37 mm), 8 mi W of Punta Redonda, *Horizon* sta A-11 Magbay Expedition, 106-116 m, 29 Jan 1964, LACM 64-237.1 (AHF 6416), USNM 267574.—1 ♂ (SL 1.76 mm), San Jaime Bank off Cabo San Lucas, *Velero III* sta 618-37, 137 m, 3 Mar 1937, LACM 37-19.16 (AHF 3717).

Description.—Shield (Fig. 1A) broader than long; anterior margins between rostrum and lateral projections somewhat concave; anterolateral margins sloping; posterior margin truncate; surface with scattered stiff setae. Rostrum acutely or obtusely triangular, terminating sharply or bluntly, and usually with slight, rounded keel. Lateral projections obtusely triangular or broadly rounded, with small submarginal spine or spinule.

Ocular peduncles usually as long as shield, stout or slightly constricted medially, and with 2 or 3 tufts of stiff setae; corneae usually slightly dilated. Ocular acicles acutely triangular, with strong submarginal spine; separated basally by at least basal length of 1 acicle.

Antennular peduncles overreaching corneae by $\frac{1}{3}$ to $\frac{3}{4}$ length of ultimate segment. Ultimate segment with 1 or 2 long, stiff setae at dorsolateral distal margin and few scattered setae. Penultimate segment with few scattered setae. Basal segment with slender spine on lateral margin medially or distally.

Antennal peduncles equaling or overreaching ocular peduncles by nearly half length of ultimate segment. Fifth and fourth segments with few scattered setae. Third

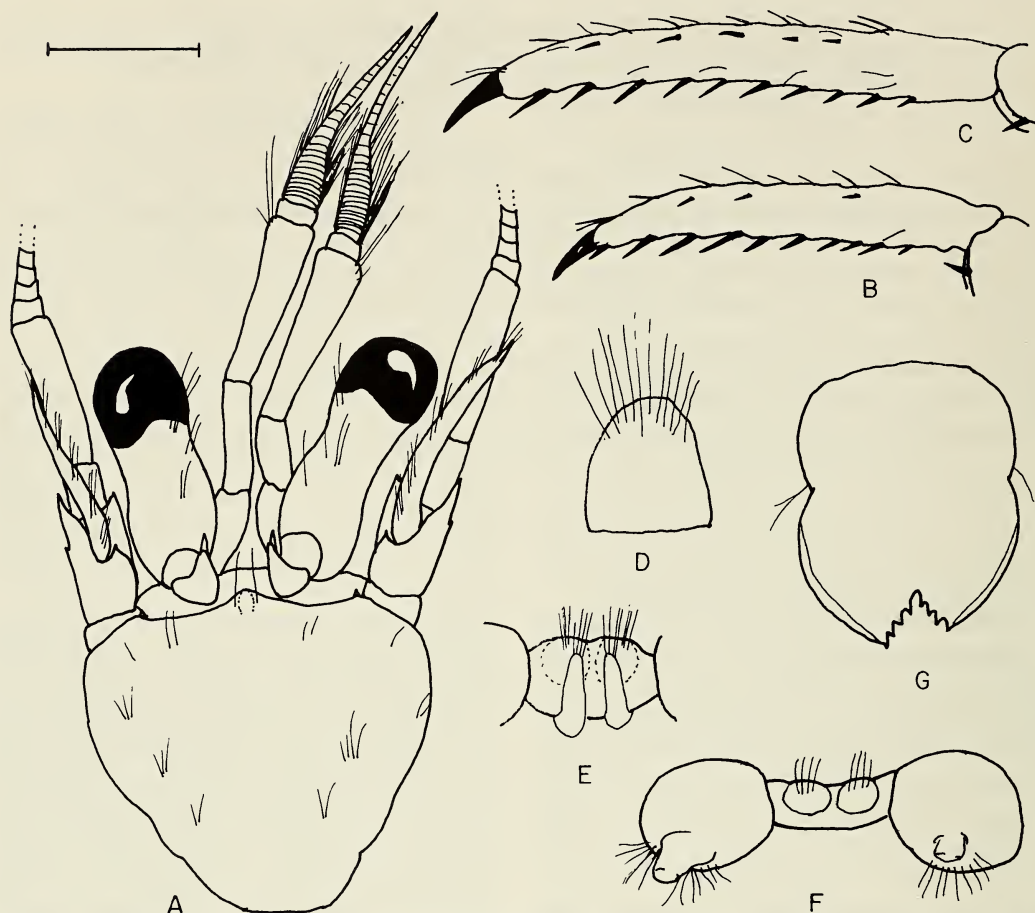


Fig. 1. *Goreopagurus garthi*, new species. A–D, G, Holotype, AHF 4926: A, shield and cephalic appendages; B, dactyl of second right pereopod (mesial view); C, dactyl of third right pereopod (mesial view); D, anterior lobe of sternite of third pereopods; E, sternite of fifth pereopods of female paratype (SL 2.3 mm), AHF 4927; F, coxae and sternite of fifth pereopod of male paratype, AHF 4135 (SL 1.7 mm); G, telson. Scale equal 1.0 mm (A–C), and 0.5 mm (D–F).

segment with strong, acute spine at ventrodistal margin. Second segment with dorso-lateral distal angle produced, terminating in acute spine and usually with strong spine on lateral margin; dorsomesial distal angle with small spine. First segment unarmed. Antennal acicle long, reaching middle of ultimate peduncular segment, arcuate, terminating in small spine; mesial surface with row of tufts of stiff setae. Antennal flagella long; articles each usually with 1 or 2 short (\leq length of 1 article) and 1 or 2 minute setae.

Third maxilliped with 1–3 tooth-like spines on basis; ischium with single accessory tooth on well developed crista dentata; merus with spine at dorsodistal margin. Sternite of third maxillipeds with tiny spinule on either side of midline.

Right cheliped (Figs. 2A, B; 3A, 4A) very elongate; palm, fixed finger and dactyl slender, somewhat dorsoventrally compressed. Dactyl $\frac{1}{2}$ to $\frac{4}{5}$ length of palm; cutting edge with 3 moderately prominent calcareous teeth in proximal $\frac{2}{3}$, row of small corneous teeth in distal third, terminating in small

corneous claw; dorsolateral margin with row of small spines or spinules or spinulose tubercles, increasing slightly in size distally, dorsal surface somewhat elevated in midline, unarmed or with single or double row of very small spinules. Palm slightly shorter than carpus; dorsomesial and dorsolateral margins each with row of very small spinules, increasing somewhat in size distally on fixed finger; dorsal surface often with row of very small spinules adjacent to dorsomesial margin, and additional scattered spinules, particularly numerous and more prominent on fixed finger; cutting edge of fixed finger with 2 moderately strong calcareous teeth in proximal half, row of small calcareous teeth in distal half, terminating in corneous claw, often worn. Carpus longer than merus, strongly produced ventrally; dorsomesial margin somewhat expanded in proximal half, armed with row of small spine, strongest proximally, dorsal surface with numerous short, transverse rows of small tubercles or spinules, dorsolateral margin usually not delimited but with transverse ridges extending onto mesial face dorsally; ventromesial and ventrolateral margins each with row of small spines or spinules, strongest on distal half of ventrolateral margin. Merus subtriangular; dorsal surface with few to numerous transverse ridges and stiff bristles; ventromesial and ventrolateral margins each with row of spines, strongest and more acute on ventrolaterally. Ischium with row of small spinules on ventromesial margin and short row of stiff bristles on lateral face ventrally.

Left cheliped (Fig. 2C, D) long and slender, but not reaching much beyond proximal margin of palm of right; dactyl and fixed finger weakly arched ventrally. Dactyl $\frac{1}{4}$ to $\frac{1}{2}$ greater than length of palm; cutting edge with row of corneous teeth, terminating in small corneous claw; dorsal surface unarmed or with few tiny spinules proximally. Palm $\frac{1}{2}$ to $\frac{2}{3}$ length of carpus; dorsolateral margin with slight ridge, unarmed or with row of minute tubercles becoming slightly

larger and somewhat more acute on fixed finger, dorsal surface strongly elevated in midline and armed with row of small spinules, becoming irregular on fixed finger, dorsal surface often with additional scattered minute spinules, particularly mesially and on fixed finger, dorsomesial margin not usually delimited, ventral surfaces with scattered tufts of long setae; cutting edge of fixed finger with row of very small calcareous teeth, interspersed distally by thin, corneous teeth. Carpus only slightly shorter to slightly longer than merus; dorsal surface somewhat flattened, dorsolateral margin with row of very small tubercles or spinules, dorsomesial margin with few tubercles or transverse ridges and stiff bristles extending onto mesial face dorsally, distal margin often with 1–3 small, blunt spinules; ventrolateral margin with row of small spines, ventromesial margin with few very small spinules. Merus subtriangular; dorsal surface with few short, transverse rows of stiff bristles; ventromesial margin with small spinules in proximal half and long stiff setae distally, ventrolateral margin with few spinules proximally and 2 or 3 acute spines distally. Ischium unarmed, but with several stiff bristles on lateral face ventrally.

Ambulatory legs (Figs. 1B, C; 2E–G) (third left pereopod missing in holotype), generally similar from left to right. Dactyls of second pereopods shorter than third, but both only slightly shorter to slightly longer than propodi; dorsal margins each with sparse row of stiff bristles, ventral margins each with row of 8–10 corneous spines, lateral faces unarmed, mesial faces each with row of corneous spinules dorsally, more numerous on third. Propodi 1 and $\frac{1}{3}$ to 1 and $\frac{1}{2}$ times length of carpi; each with 1 or 2 corneous spinules at ventrodiscal angle and row of widely-spaced corneous spinules on ventral margin, dorsal surfaces each with row of stiff bristles. Carpi each with small spine at dorsodistal margin, few stiff setae arising from low protuberances on dorsal surface and 1 or 2 stiff setae on ventral mar-

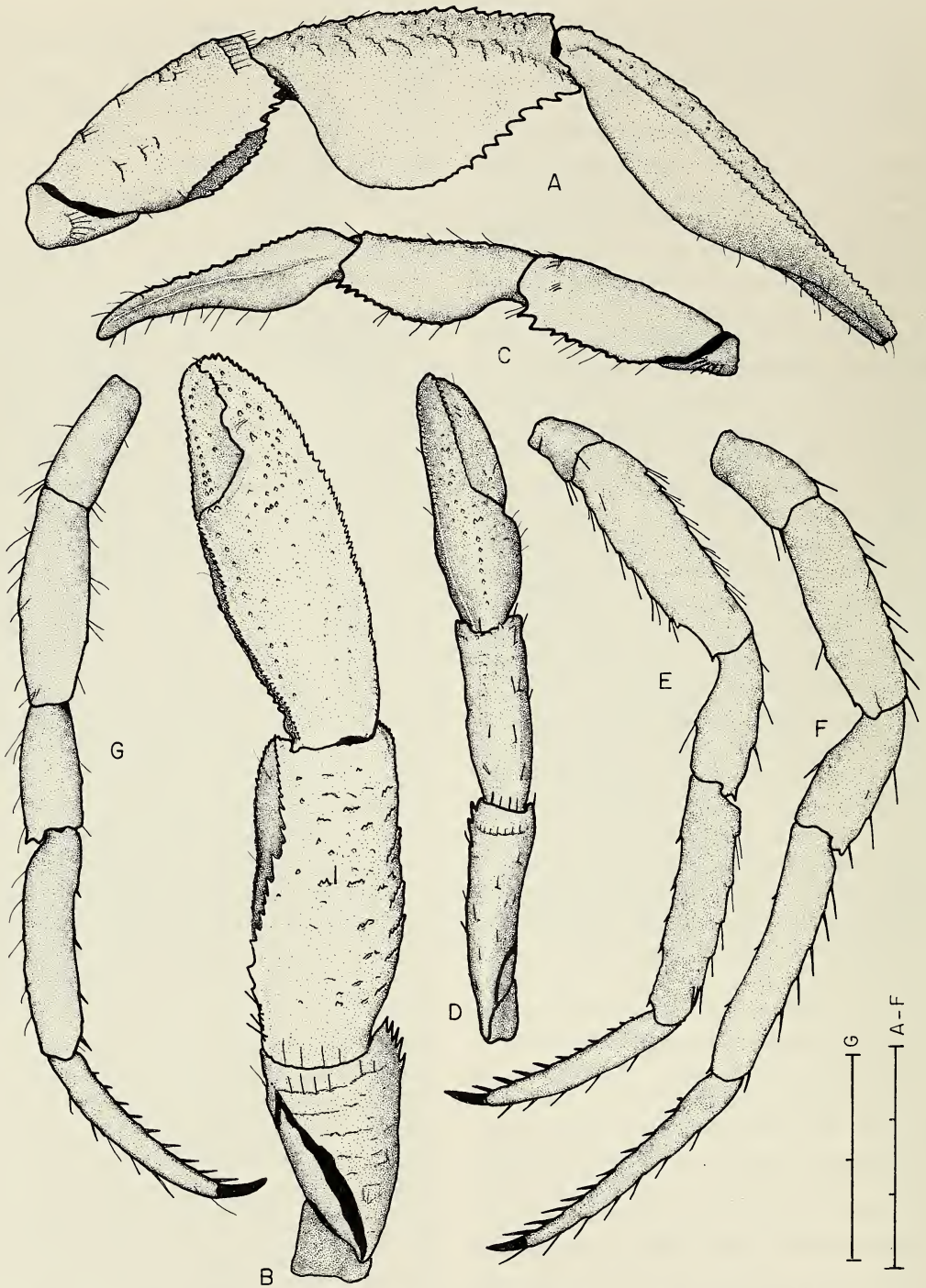


Fig. 2. *Goreopagurus garthi*, new species. A-F, Holotype AHF 4926:- A, right cheliped (lateral view); B, right cheliped (dorsal view); C, left cheliped (lateral view); D, left cheliped (dorsal view); E, second right pereopod (lateral view); F, third right pereopod (lateral view); G, third left pereopod of male paratype, AHF 4135 (SL 1.7 mm). Scales equal 3 mm (A-F) and 2 mm (G).

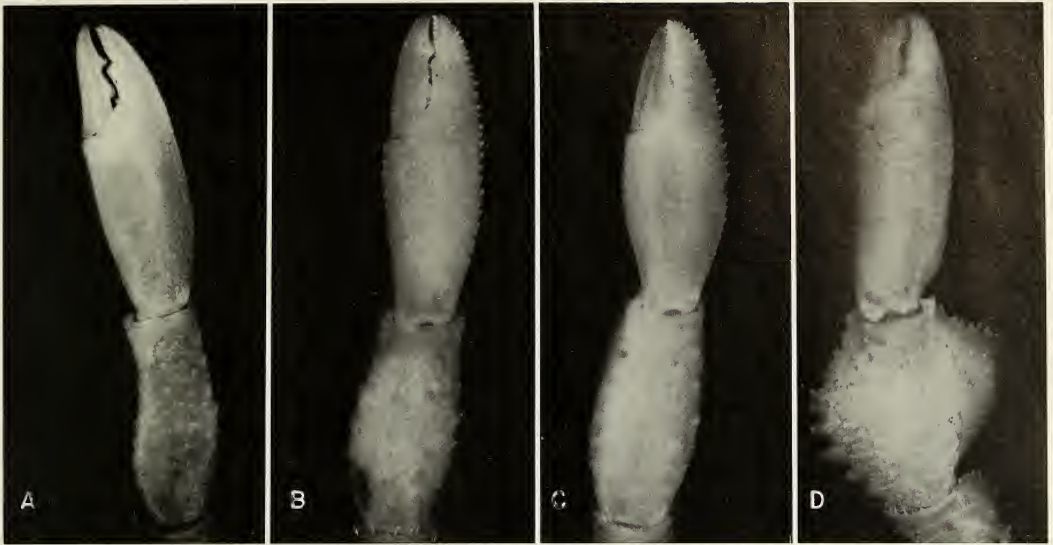


Fig. 3. Right cheliped (dorsal view): A, *Goreopagurus garthi*, new species, ovigerous female, AHF 4135 (SL = 2.3 mm); *Goreopagurus piercei* (Wass), B, ovigerous female, HBOM 089:06382 (SL = 1.8 mm); C, immature male, HBOM 089:06382 (SL = 1.4 mm); D, mature male, HBOM 089:06379 (SL = 1.6 mm). Magnifications equal: A, 10.4 \times ; B, 19.0 \times ; C, 19.8 \times ; D, 11.0 \times .

gin medially. Meri with transverse, short ridges and stiff bristles or setae on dorsal surfaces, tufts of stiff setae and occasionally 2 or 3 often spinulose protuberances or small spinules on ventral surfaces, ventrolateral distal angles each with acute spine, appreciably smaller and sometimes absent on third pereopods. Ischia unarmed but with few stiff setae or bristles.

Sternite of third pereopods with semisubovate anterior lobe (Fig. 1D) provided with stiff bristles on anterior margin. Fourth pereopods with small preungual process at base of claw. Females with 2-segmented pleopods modified as gonopods (Fig. 1E) on first abdominal somite; fifth pleopod with endopod rudimentary. Males with quite short sexual tube (Fig. 1F) on coxa of right fifth pereopod (damaged in holotype), and with or without very short left sexual tube. Telson (Fig. 1G) with transverse suture; posterior lobes separated by shallow median cleft, terminal margins oblique, each with 3–5 small spines, outermost usually largest,

lateral margins delimited by narrow chitinous band.

Etymology.—The specific name is given in honor of the late Dr. John S. Garth, in recognition of his many years of contributions to eastern Pacific carcinology.

Distribution.—At present known only from the outer coast of Baja California, Mexico, from Isla Cedros in the north to Cabo San Lucas in the south; 95–119 m.

Remarks.—*Goreopagurus garthi*, like *G. piercei*, is a very small species, with females mature (ovigerous) at shield lengths of only slightly more than 1 mm. However, clearly *G. garthi* is the larger of the two. McLaughlin (1988) reported a maximum shield length of 1.8 mm in 171 specimens of *G. piercei* examined, including the holotype. In our very small sample of *G. garthi*, shield lengths ranged from 1.2 to 2.3 mm. McLaughlin remarked that shield length in *G. piercei* was somewhat misleading, because of the tendency of the shield to increase in breadth with overall increase in animal size.

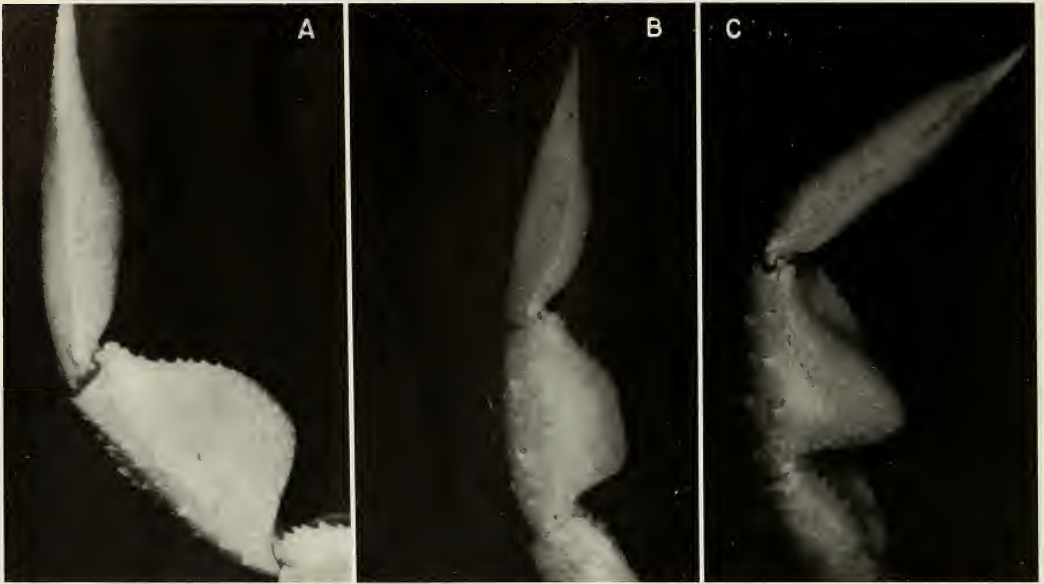


Fig. 4. Right cheliped (lateral view): A, *Goreopagurus garthi*, new species, male holotype, AHF 4926 (SL = 2.3 mm); *Goreopagurus piercei* (Wass), B, immature male, HBOM 089:06382 (SL = 1.4 mm); C, mature male, HBOM 089:06379 (SL = 1.8 mm). Magnifications equal: A, 12.6 \times ; B, 16.7 \times ; C, 10.8 \times .

Since we had no specimens with shield lengths less than 1.0 mm, we had not seen this trend in *G. garthi*. In both males and females, the shield was consistently broader than long.

McLaughlin noted marked sexual dimorphism in *G. piercei*, exhibited particularly by development of the carpus of the right cheliped in males. In mature females and small males (Fig. 3B, C) there was only a slight tendency for the dorsal surface of the carpus to be expanded mesially. In mature males, this expansion was pronounced (Fig. 3D). In contrast, males and females of *G. garthi* exhibited very similar, obvious, but relatively weak, expansion in the carpus of the right cheliped (Figs. 2B, 3A). The ventral inflation of the carpus is conspicuous in both species (Figs. 2A, 4A–C); however, in *G. piercei* it is much less accentuated in small males.

Development of the male sexual tubes was not as pronounced in *G. garthi* as in *G. piercei* (cf. McLaughlin 1988:fig. 2f). Given the overall larger size of the Pacific species, it

is quite possible that the males of *G. garthi* that we have examined were not yet fully mature. The sexual tubes of the male from Isla Cedros (Fig. 1F) were the most developed of all the males in our samples. The right coxa of the holotype male was damaged, thus the development of the sexual tube could not be ascertained; however, there was only a vestige of a left sexual tube in this specimen. If these males of *G. garthi* were not sexually mature, it is possible that in mature males sexual dimorphism of the carpus of the right cheliped might be manifest in the Pacific species as well.

Whether or not marked sexual dimorphism in the carpus of the right cheliped proves to be an attribute of *Goreopagurus*, this is a very distinctive genus. The minor emendations made to the generic diagnosis pertain to such interspecifically variable characters as the presence or absence of spines on the dorsodistal margin of the merus and sternite of the third maxillipeds, and the shape of the sternite of the third pereopods. Although McLaughlin (1975) and

Lemaitre et al. (1982) found the median projection of the sternite of the third maxilliped to be a diagnostic character for the *provenzano* group of *Pagurus*, the presence or absence of a spine on either side of the midline is variable (e.g., McLaughlin & Gunn 1992). Squires (1964) and McLaughlin (1974) both found the shape of the sternite of the third pereopods a generally reliable character for separating closely related species; however, at the generic level it is not as dependable (e.g., McLaughlin & Haig 1989). The dactyls of the ambulatory legs were reported as relatively short in *G. piercei*. They are of generally similar length per animal size in *G. garthi*.

Acknowledgments

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